

Fire Fighting Robot using Arduino and Motor Drivers with Obstacle Detection

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ABSTRACT

We see new inventions and discoveries being made every single week. Be it in medical science, commercialization, globalization, defence warfare or digital advancements. Increasing infrastructural marvels also increases concerns about basic safety measures like fire protection. In this study, we have designed a prototype for a fire fighting robot and discussed ways in which it can be useful to fire fighters during fire safety drills.

KEYWORDS: *Arduino, Battery, Detection, Drivers, Fire, Motor, Obstacle, Programming, Robot, Sensors, Servo, Ultrasonic*

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1. INTRODUCTION

Humans are progressing at an unprecedented rate in the growing world of technologies and infrastructure. The number of high-rise buildings and towers that can be seen today is a testament to that fact. Such buildings are made with a lot of thought processes behind them.

With such big structures, ensuring the safety of all the individuals inside those buildings is paramount. On-site engineers pay special attention towards ensuring that the building passes all the necessary safety checks. Besides that, they also have to ensure timely maintenance of all the safety measures. Large buildings, towers, flyovers, etc. require electricity for their respective functionalities.

Any abnormality in normal working conditions in these places can very easily lead to a fire, which is one of the most common threats that is being faced. The fire, if caused, can either be small or big depending upon the extent of fault/failure in the system. However, mitigating the fire, no matter how big or small, is very necessary.

Fire fighters put their life on the line to doze off the fire as quickly as they possibly can. However, there are certain spots in a specific area which are difficult for even the Fire fighters to reach as they are life-threatening. In such situations, a small and mobile robot can be really handy. It can get into spaces where humans can't and try to limit the extent of the fire to some extent. And this is the major objective behind this study, which is to ease the operations of Fire fighters in extinguishing the fire using portable robots or robotic cars.

Nowadays, robotic design and machinery have become very important in helping humans. The fire fighting robot was implemented to help humans in hazardous situations. A fire fighting robot is capable of extinguishing fire with the help of powered electronic sensors. Our research paper reports the design of a small automatic fire-extinguishing robot. The fire-fighting robot is enabled to search the fire for an area of specific dimensions with the help of multitasking sensors commanded by Arduino Uno.



Fig. 1: The model of the fire-fighting robot.

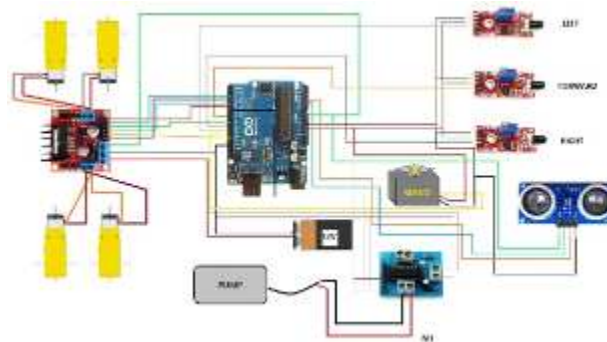


Fig. 2: Circuit diagram of the fire-fighting robot.

2. OVERVIEW OF COMPONENTS

For making this fire-fighting robot, we have mounted all the working components on a 30x17x1.5 (in centimetres) plywood. We have made use of Arduino UNO, which is an open-source microcontroller board on which we have compiled our program to make our robot work. For the operation of the motors, we are using the L298N motor driver. This driver rotates the motor in a fixed direction by keeping one of the pins as high while keeping the other one as low. The motors used for the wheels are simple Battery Operated (BO) motors.

We have made use of a Servo motor for mounting our pipe which is fixed to a 5 volts pump. To operate the submersible water pump we have used an L293D motor driver. The complete robot is powered by a 12 volts rechargeable battery. For water storage, we have used a medium-sized polymer box ensuring that it is completely leakage-proof to prevent any damage to the components which are mounted for working.

For sensing the fire we are using three flame sensors which are mounted in three different directions to sense the presence of flame from the direction of its origin.

For detecting obstacles that may be faced by the fire-fighting robot on its path, we have made use of the HC-SR04 ultrasonic sensor. The sensor is programmed to operate with the Arduino Uno in a way that it can precisely detect obstacles on its way and instruct the robot to navigate freely without hindrance. For all the connections we have used regular jumper wires and their types viz. Male-to-male, male-to-female and female-to-female.

3. WORKING

The heart of the fire fighting robot is the Arduino UNO microcontroller board. The connections from the flame sensors, L298N motor driver, L293D motor driver, pump, Servo motor as well as the ultrasonic sensor are all made to the respective pins on the Arduino Uno board.

The wheels of the robot are driven by an L298N motor driver while the pump is driven by the L293 motor driver. The connections of the Servo motor are made to the Arduino. The Servo rotates at the specific angles set by programming in the Arduino IDE.

Under normal conditions when there is no fire, the robot can move freely avoiding obstacles on its path due to the ultrasonic sensor which is employed. The sensor detects the distance with the help of the ultrasonic waves and then the robot decides the trajectory for itself, whether to move towards the left, right, forwards or backwards. The angle at which the ultrasonic sensor rotates to detect obstacles is adjustable and can be modified in the Arduino IDE and re-uploaded to the Arduino Uno microcontroller board as per our requirements.

The fire-fighting robot is programmed in such a way that when any kind of obstacle is sensed by the robot with the help of the ultrasonic sensor, the robot analyses the best path of movement and moves towards it. Example: When the motor decides to make a right turn owing to obstacles in its path, then the wheels on the left-hand side of the robot are programmed to rotate in a clockwise motion while the wheels on the right-hand side of the motor are programmed to rotate in an anticlockwise motion. Similarly, when the robot decides to make a left turn, then the wheels on the right-hand side of the robot rotate in a clockwise motion while the wheels on the left-hand side of the robot rotate in an anticlockwise motion.

When the flame sensor detects the presence of fire, anywhere near, then they are activated as per the code that is written in the Arduino IDE. As a result of which, it pauses the wheels and then activates the pump.

The pump then sends water through a pipe mounted over the Servo. The Servo motor then equally spreads the water at the site of the fire through the pipe within the angle specified in the code. The angle at which the servo rotates is adjustable and can be modified as per requirement by making changes in the code where the angle of rotation for the same is defined.

Once the fire is dozed away completely, the pump stops and the robot is again set in motion. The fire-fighting robot will start operating again by detecting obstacles on its way and it will move forward. When the flame sensors sense fire ahead of it then the entire process of pumping out water to extinguish the fire is repeated again.

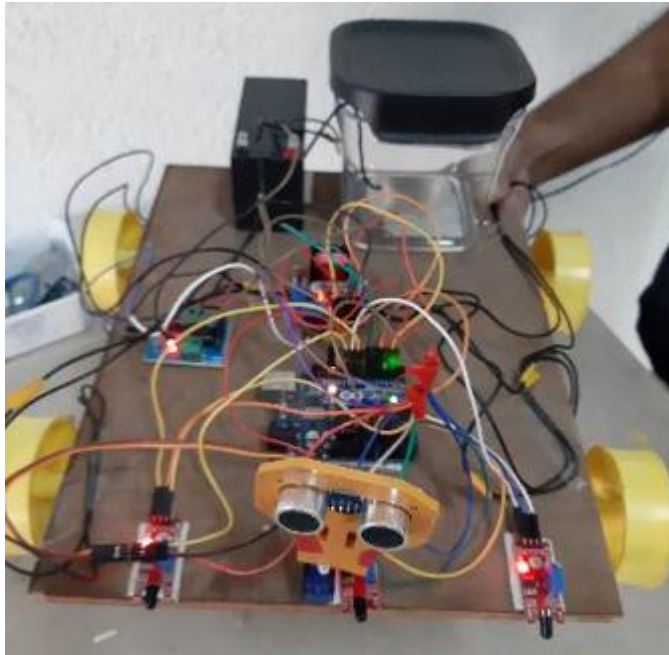


Fig. 3: The fire-fighting robot in a working state.

4. CONCLUSION

This paper has described a specific objective of the concepts which are used in the particular area. The project presents the implementation of fire-fighting robots that move towards the fire and pump out water to extinguish the fire.

The project describes the methodology of interfacing of various components to the Arduino. The fire

fighting robot also successfully anticipates avoiding obstacles from the path by using an ultrasonic sensor to clear the path.

The project is capable of freely navigating towards the fire and then extinguishing it by pumping water was successfully made.

5. REFERENCES

- [1] K. Shamili Devi, K. Akhileswar, CH. Vinayaka, M. Karthik, and Y. K. Viswanadham. "FIRE FIGHTING ROBOT", Volume XII, Issue VII, July/2020, The International Journal of Analytical and experimental modal analysis.
- [2] Finding solutions to doubts on <https://forum.arduino.cc/> regarding interfacing of components, connections, optimum operating conditions, and safety measures with the project.
- [3] Datasheet for the L298N motor driver referred from https://components101.com/sites/default/files/component_datasheet/L298N-Motor-Driver-Datasheet.pdf
- [4] Datasheet for L293 motor driver referred from <https://www.ti.com/lit/ds/symlink/l293.pdf>
- [5] Datasheet for HC-SR04 Ultrasonic sensor referred from <https://www.electroschematics.com/wp-content/uploads/2013/07/HCSR04-datasheet-version-1.pdf>